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GIANT MAGNETOIMPEDANCE OF FeNi-BASED NANOSTRUCTURES DEPOSITED ONTO GLASS AND FLEXIBLE SUBSTRATES

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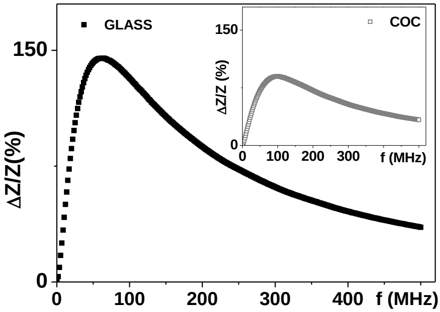
The giant magneto-impedance (GMI) effect is the great change of the electrical impedance that soft ferromagnetic materials exhibit when a magnetic field is applied. It is based on the skin effect, consisting in the change of the skin penetration depth of the electromagnetic field in a conductor. GMI research is of great interest due to the potential technological and biomedical applications as small magnetic field sensors. GMI sensors presently have the highest sensitivity to a magnetic field in the standard technological temperature range of -50 to 120^{o}C. Flexible substrates are an attractive solution for GMI biosensors, which could be directly incorporated into the microfluidic systems.

In this work, we have designed a $[FeNi(170\ nm)/Ti(6\ nm)]_3/Cu(500\ nm)/[Ti(6\ nm)/FeNi(170\ nm)]_3$ multilayer and deposited it onto a rigid glass and onto Cyclo Olefine Copolymer (COC) flexible substrates. The multilayered structure was prepared by rf-sputtering with metallic masks under a constant magnetic field of 250 Oe that was applied parallel to the film plane in order to induce a well-defined transverse magnetic anisotropy. In thin films, it is necessary to use frequencies in the MHz range in order to obtain the high impedance variation. The magneto-transport measurements at these frequencies must be performed using radio-frequency (RF) techniques. The GMI results presented in this work are based on the measurements of the scattering parameters using a vector network analyser when the sample inserted in a microstrip transmission line [1].The GMI ratio $\Delta Z/Z$ was defined with respect to the value at the maximum field H_{max}= 150 Oe: $\Delta Z/Z = 100\times([Z(H)-Z(H_{max})]/ Z(H_{max}))$.

Figure below shows the frequency dependence of the maximum GMI for the samples deposited onto glass and COC substrates, respectively. For the sample deposited onto a glass substrate 145% ratio of impedance change is found at 64 MHz, whereas for the sample deposited onto COC substrate, the maximum ratio is 89% at 97 MHz. Although value of GMI variation is significantly higher for the multilayer deposited onto rigid substrate, the ΔZ/Z variation of the order of 90% for COC substrate is also promising for magnetic sensor applications. More work is necessary in order to achieve GMI values for flexible substrates close to the best values available for rigid substrates.



Frequency dependence of the GMI ratio for multilayer deposited onto glass and COC substrates

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СИНТЕЗ УЛЬТРАДИСПЕРСНОГО ПОРОШКА ОКСИДА КОБАЛЬТА

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Технологические разработки в области твердых сплавов продолжают совершенствоваться и развиваться. Особенно активно, в последнее время, ведутся исследования в направлении использования принципов нанотехнологии, которые способствуют достижению в сплавах повышенной прочности, коррозионной стойкости, вязкости и пластичности.